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Larson

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(54) **MOISTURE DIVERSION SYSTEMS AND METHODS OF USING SAME**

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B64C 1/06 (2006.01)

(52) **U.S. Cl.**
CPC ***B64C 1/066*** (2013.01); ***B64C 1/067*** (2013.01)

(58) **Field of Classification Search**
CPC B64C 1/066; B64C 1/406; B64C 1/067; B64C 1/143
See application file for complete search history.

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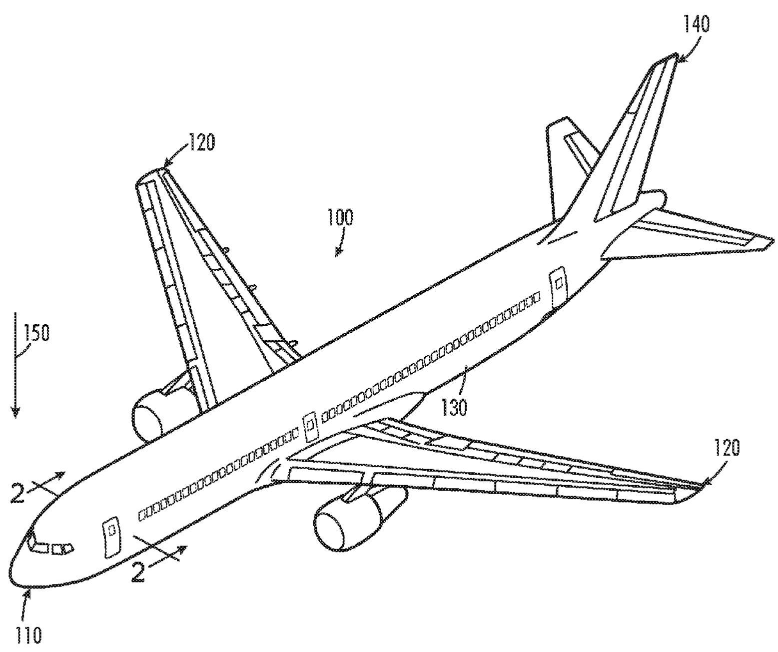
(57) **ABSTRACT**

A moisture diversion system of an aircraft for capturing moisture from at least one internal aircraft structure or at least one gap, the moisture diversion system comprising: a drip shield with an upper surface having a concave shape, at least one moisture channel disposed in the upper surface of the drip shield, the drip shield being in a moisture capturing orientation under the at least one internal aircraft structure or the at least one gap.

19 Claims, 20 Drawing Sheets



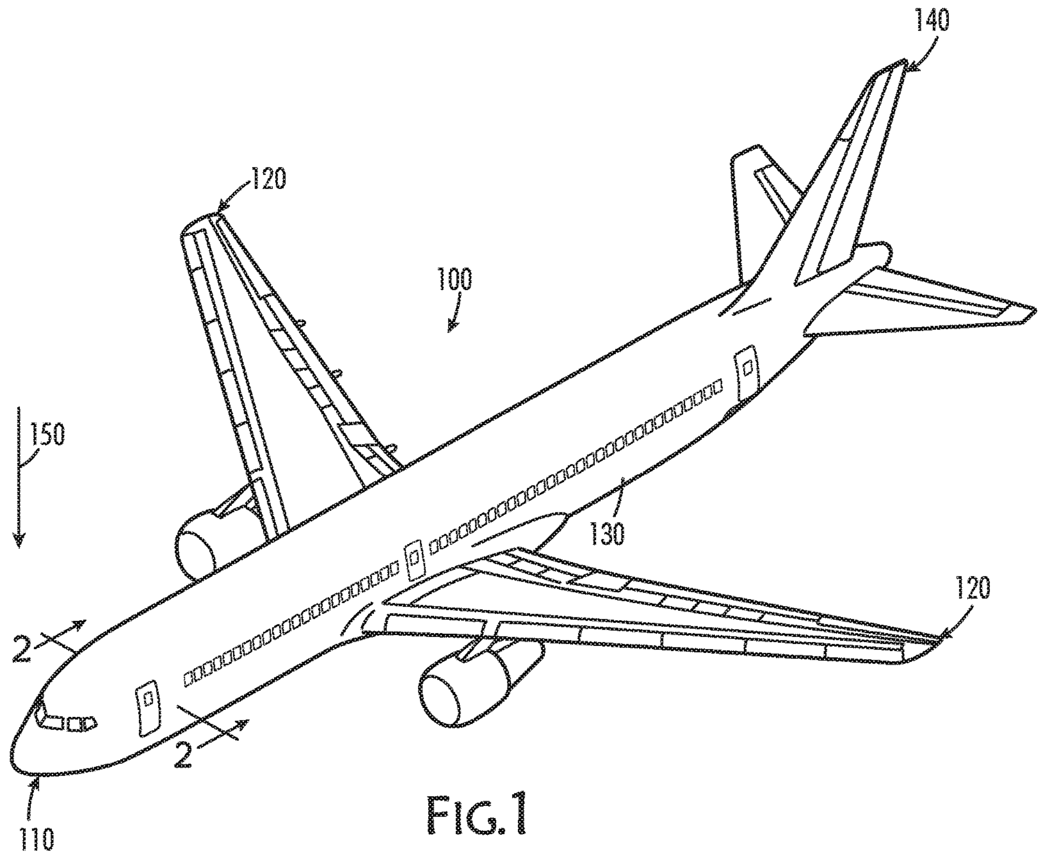
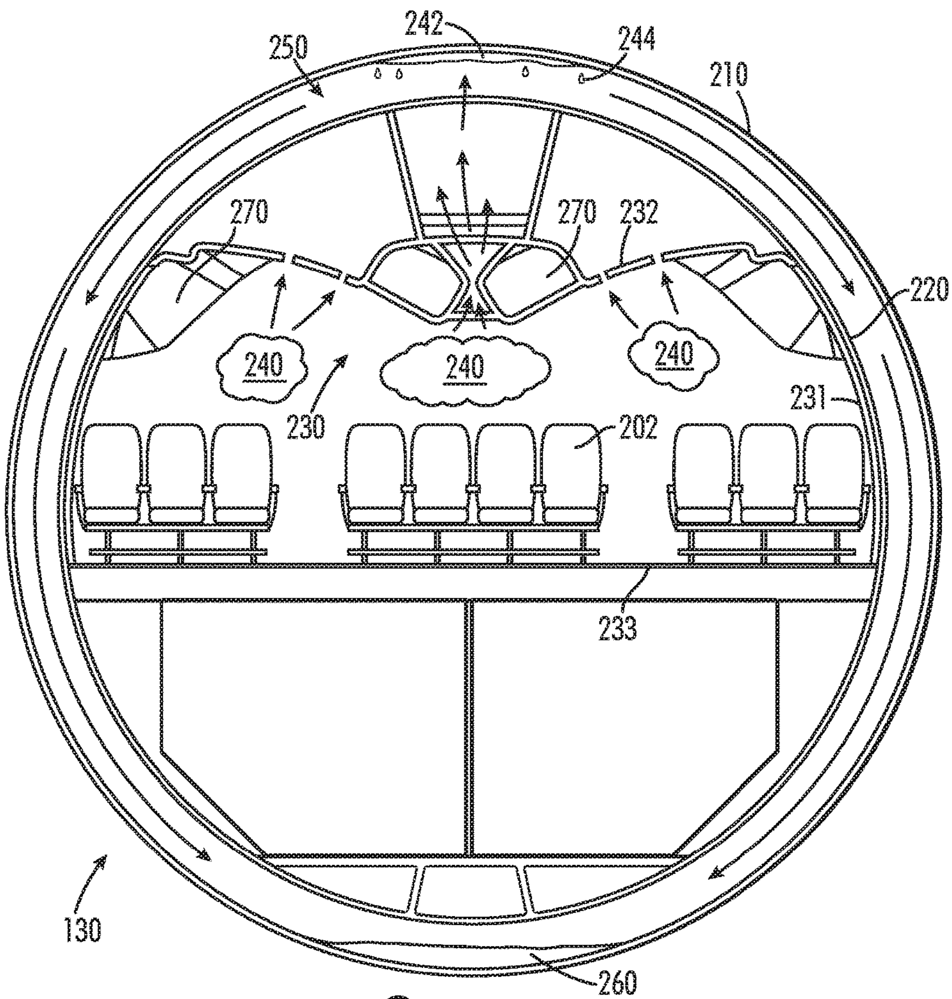


FIG.1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244
250
210
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220
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130
260

FIG.2

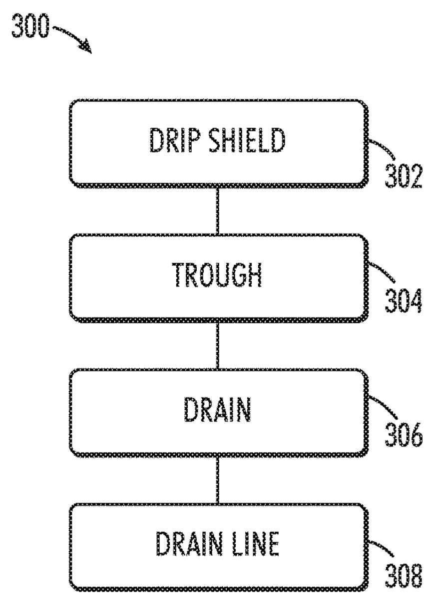
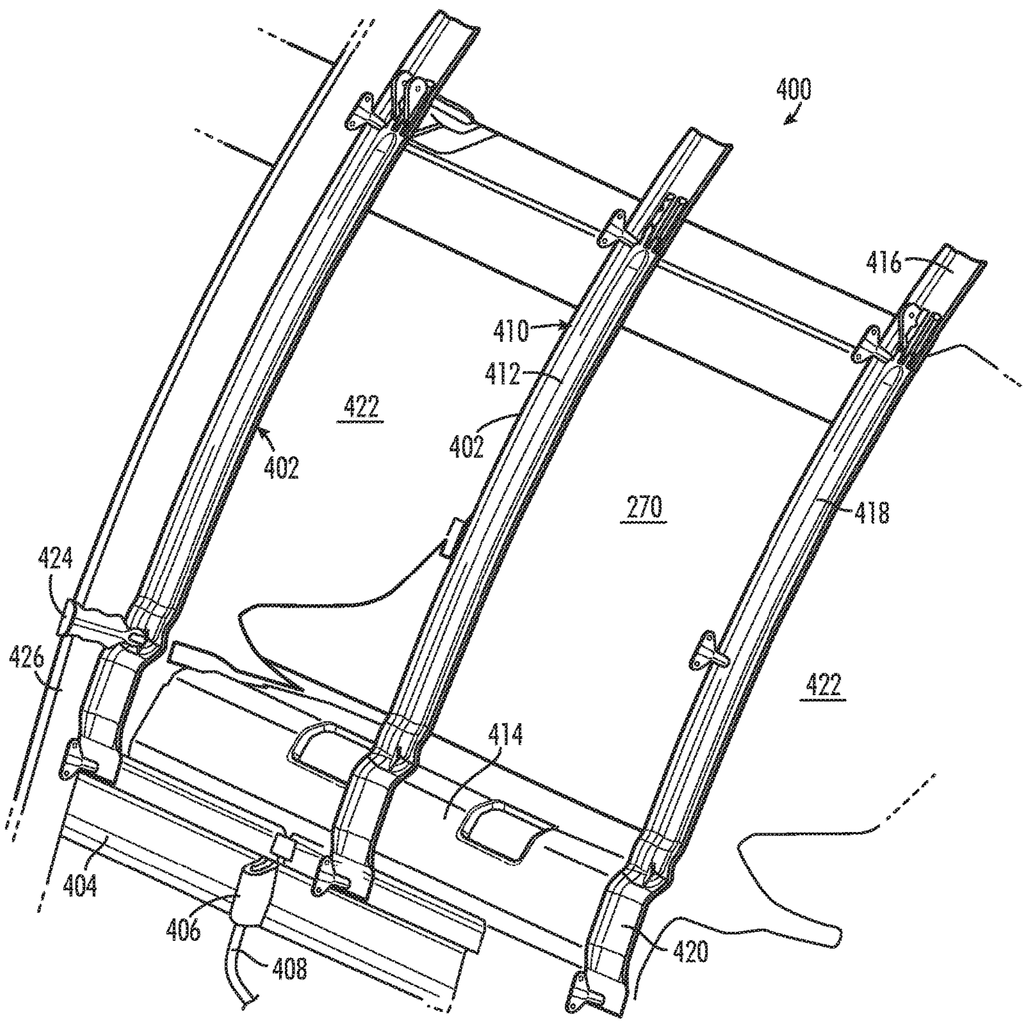


FIG. 3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416
410
412
422
402
402
270
418
424
426
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404
406
408
420

FIG. 4

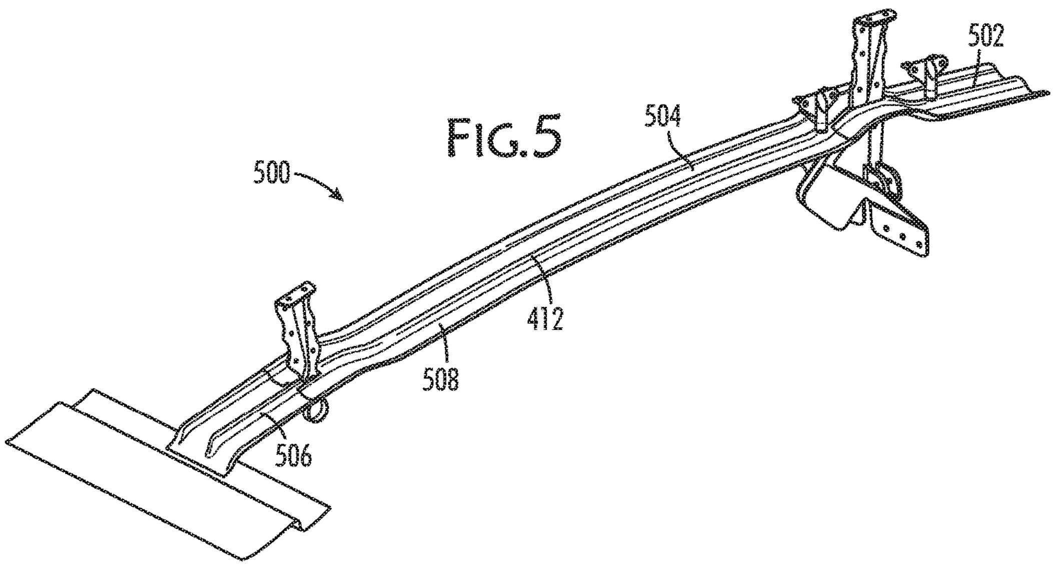

FIG. 5

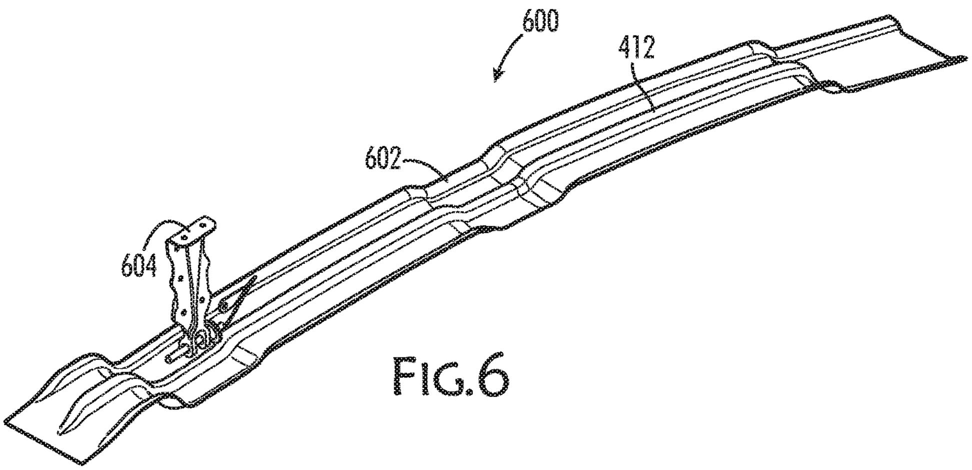

FIG. 6

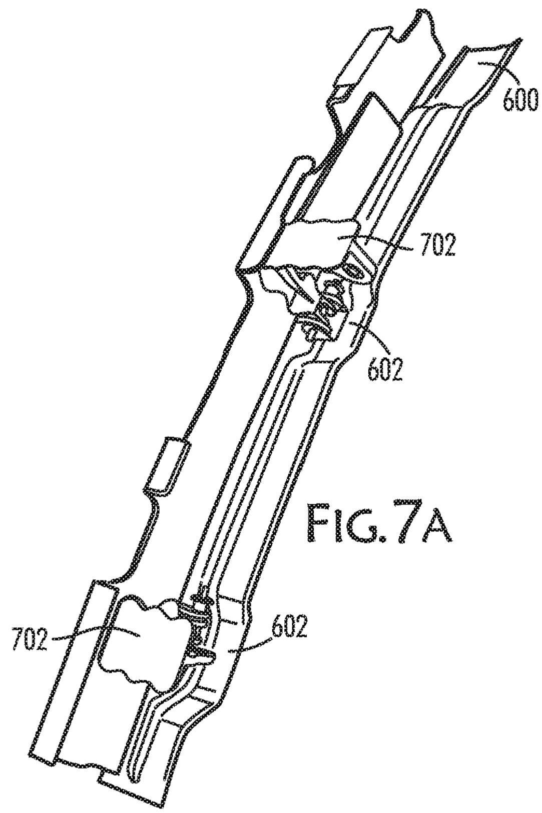

FIG. 7A

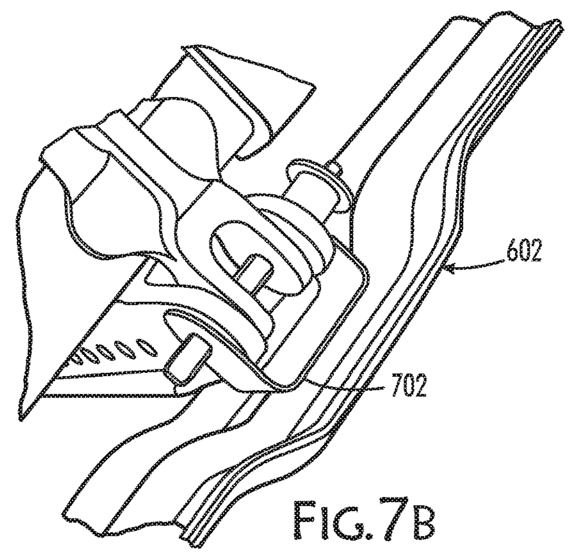

FIG. 7B

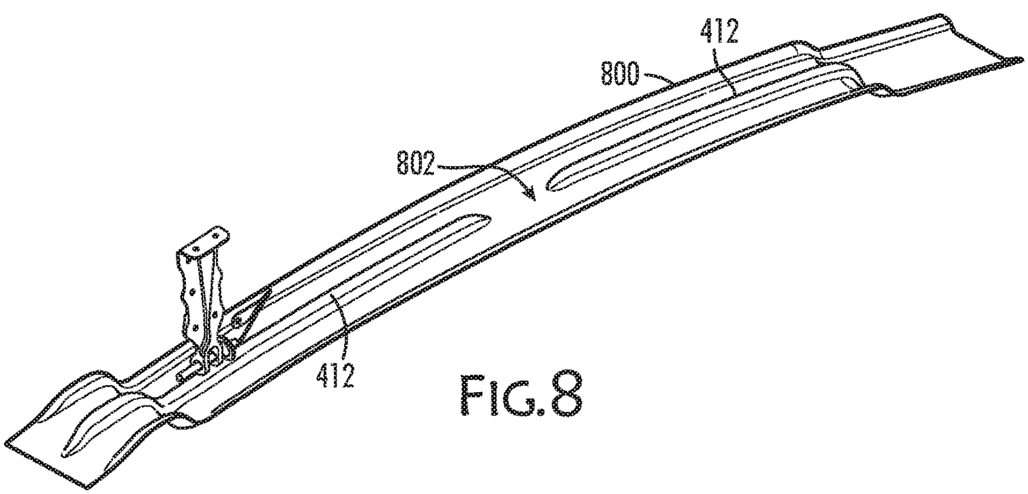

FIG.8

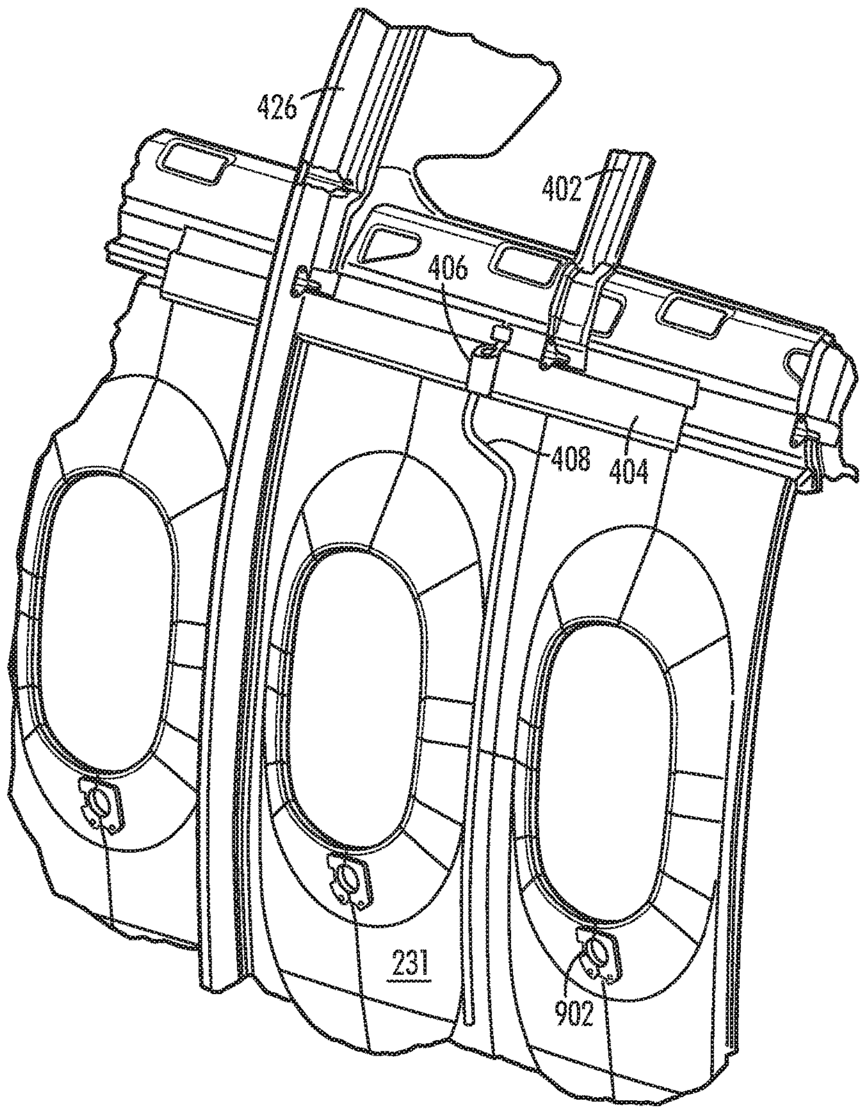

FIG. 9

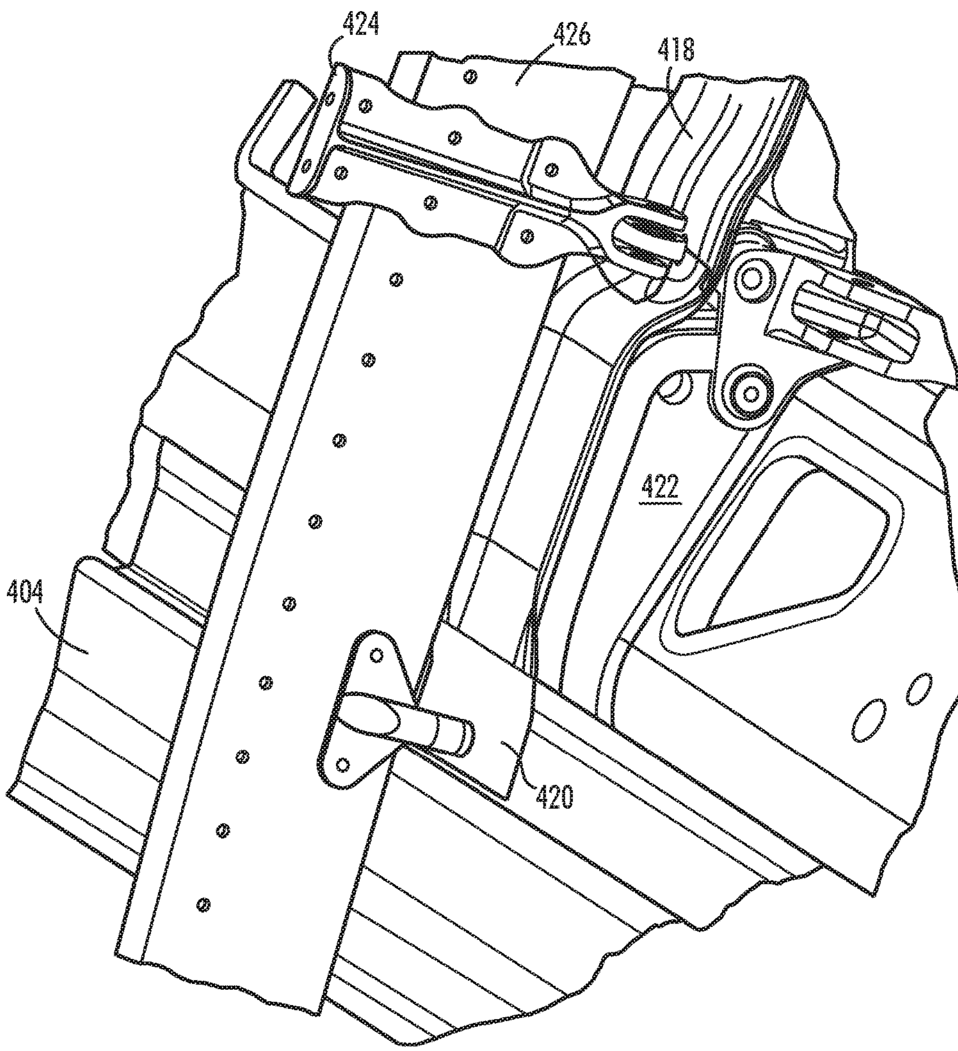

FIG.10

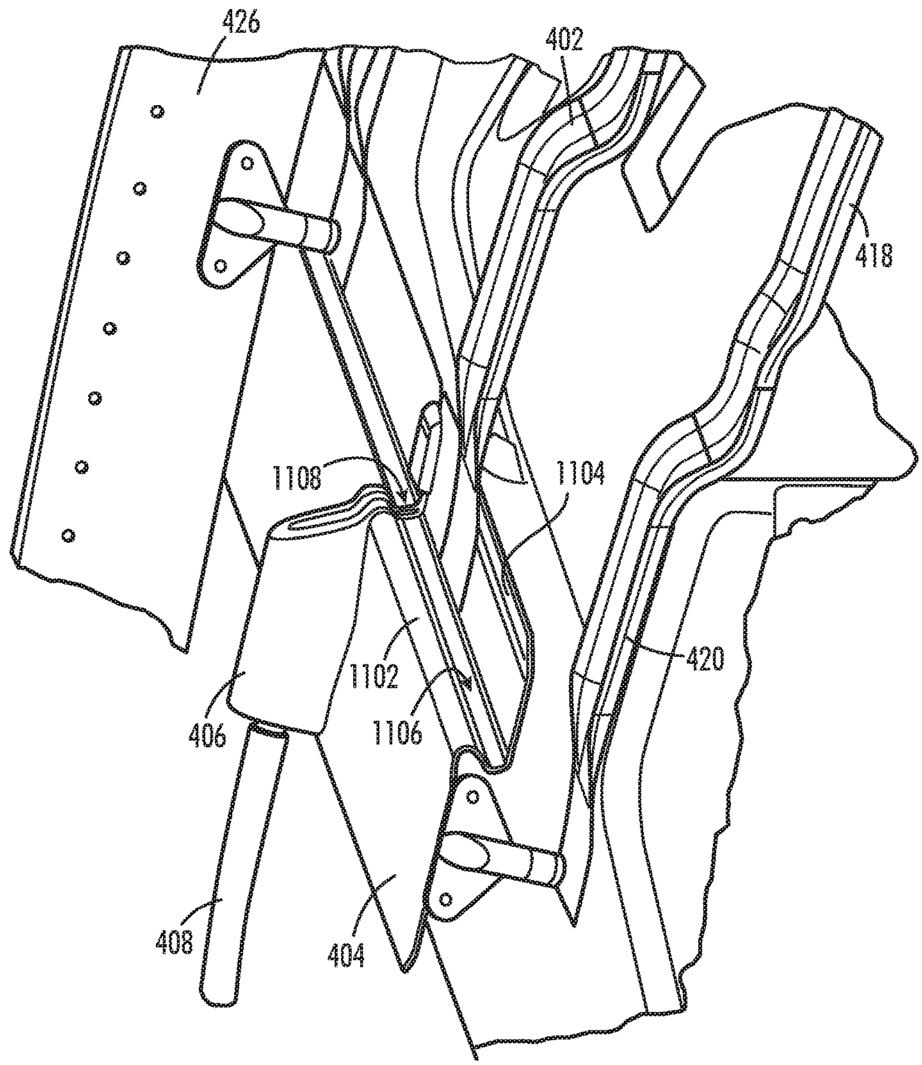

FIG.11

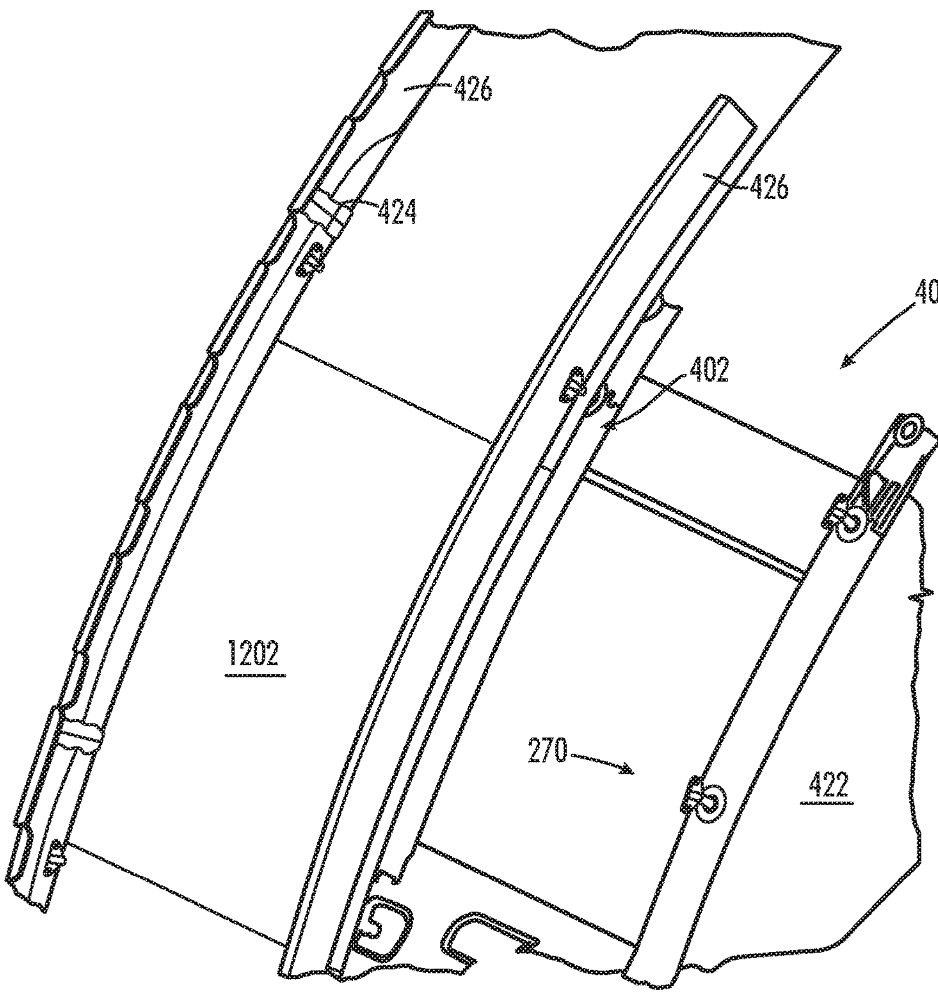

FIG.12

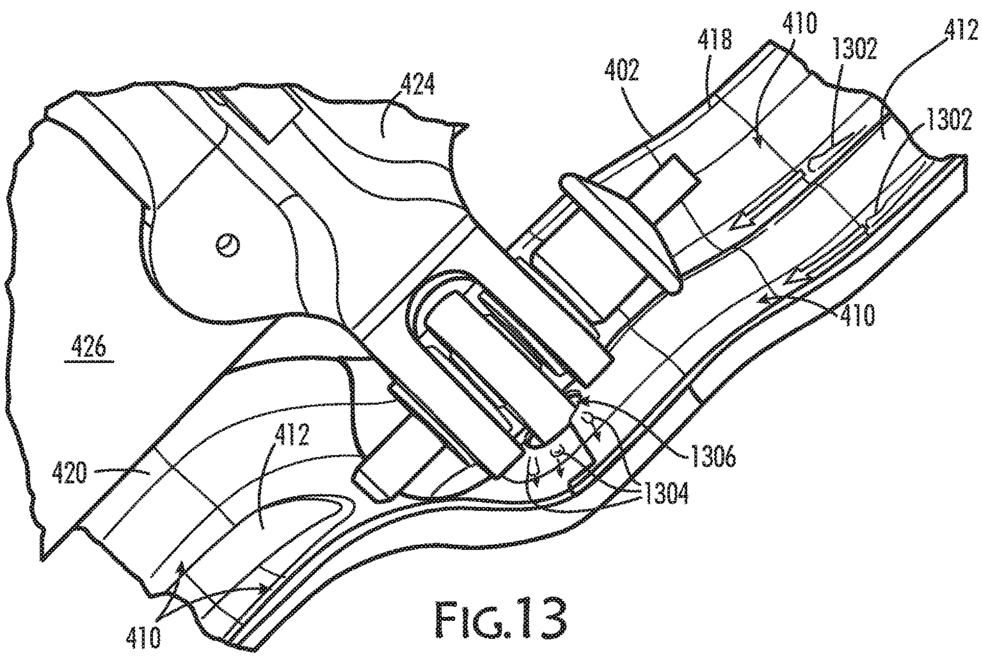

FIG. 13

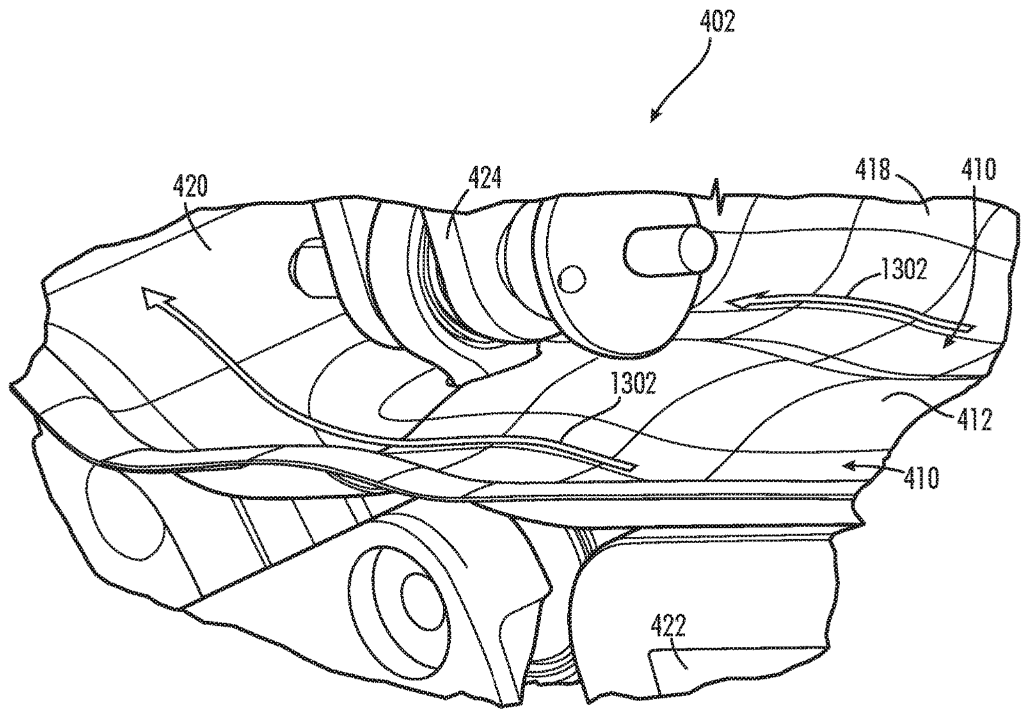

FIG. 14

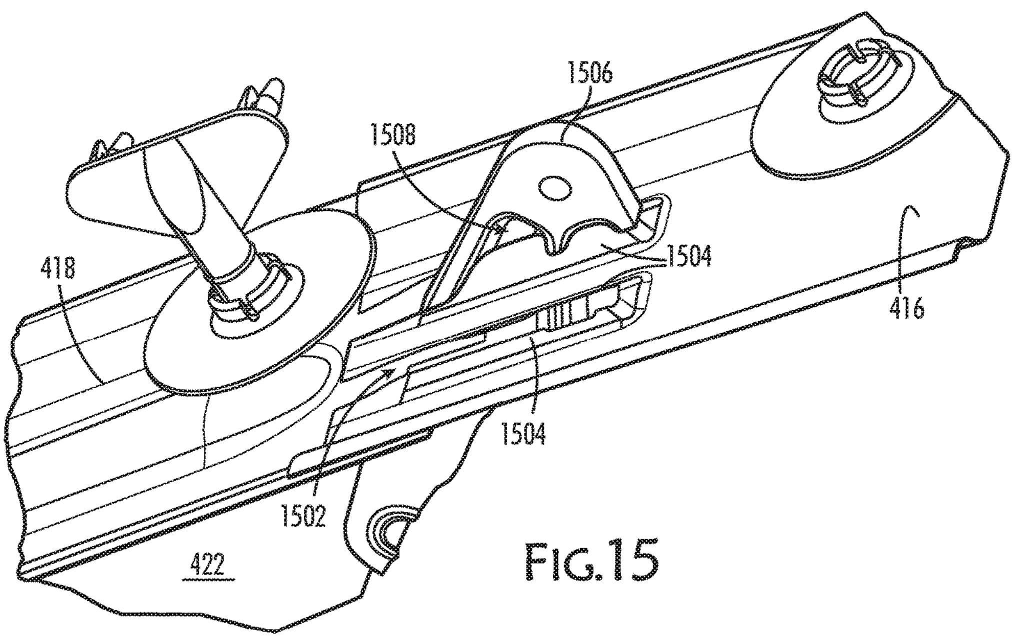

FIG.15

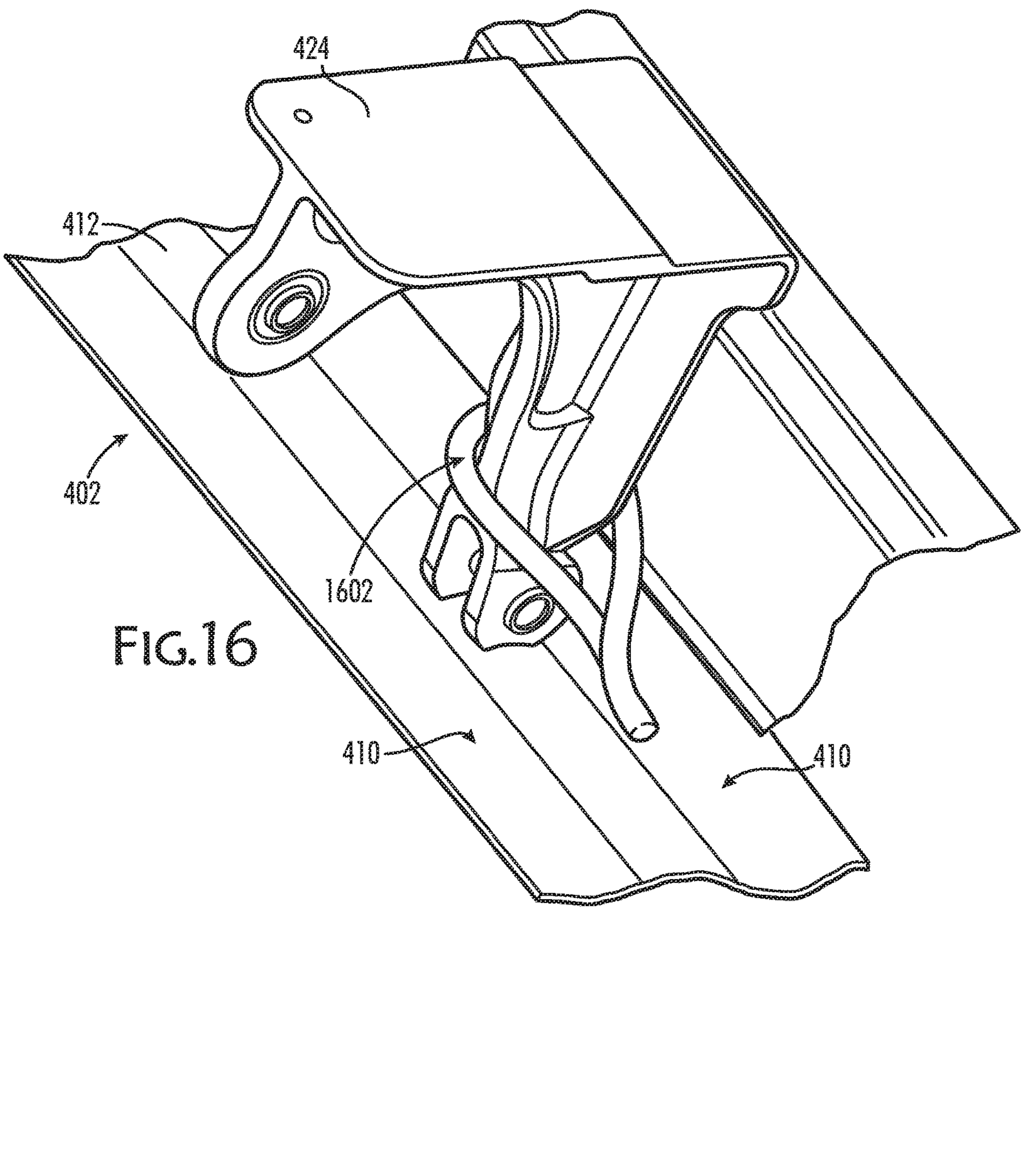

FIG.16

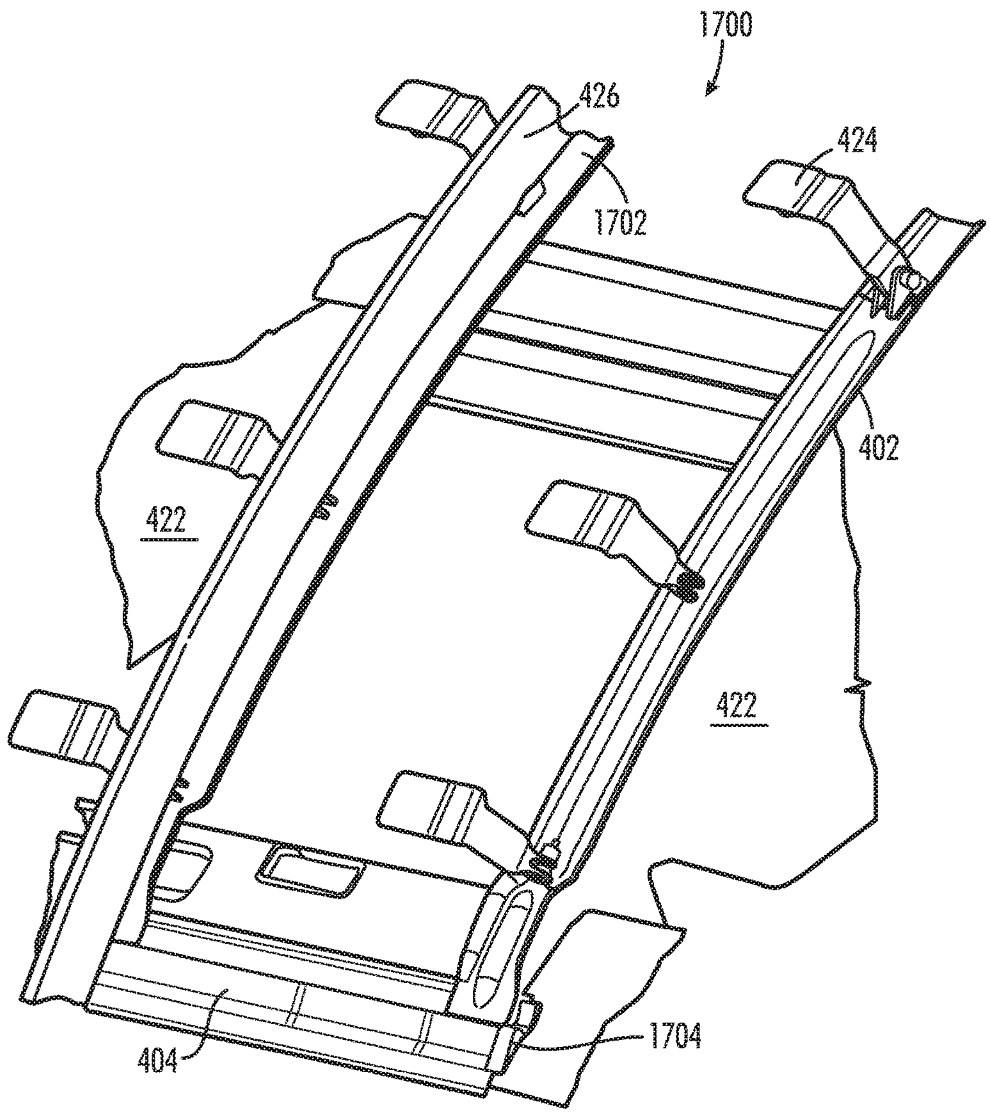

FIG.17

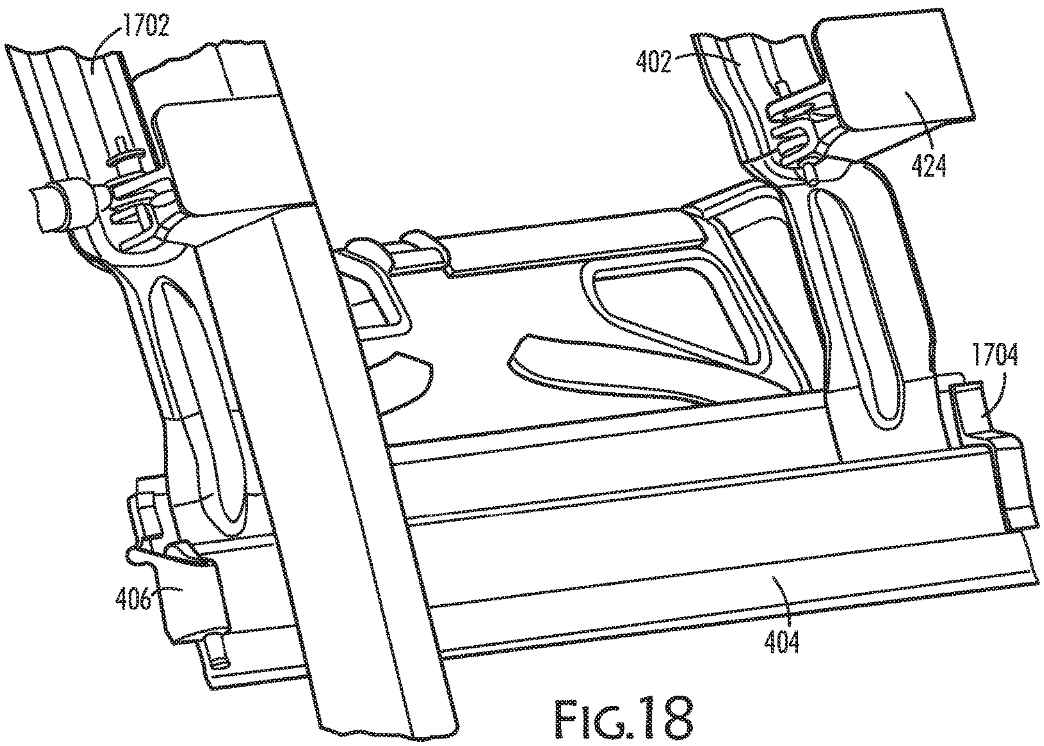

FIG.18

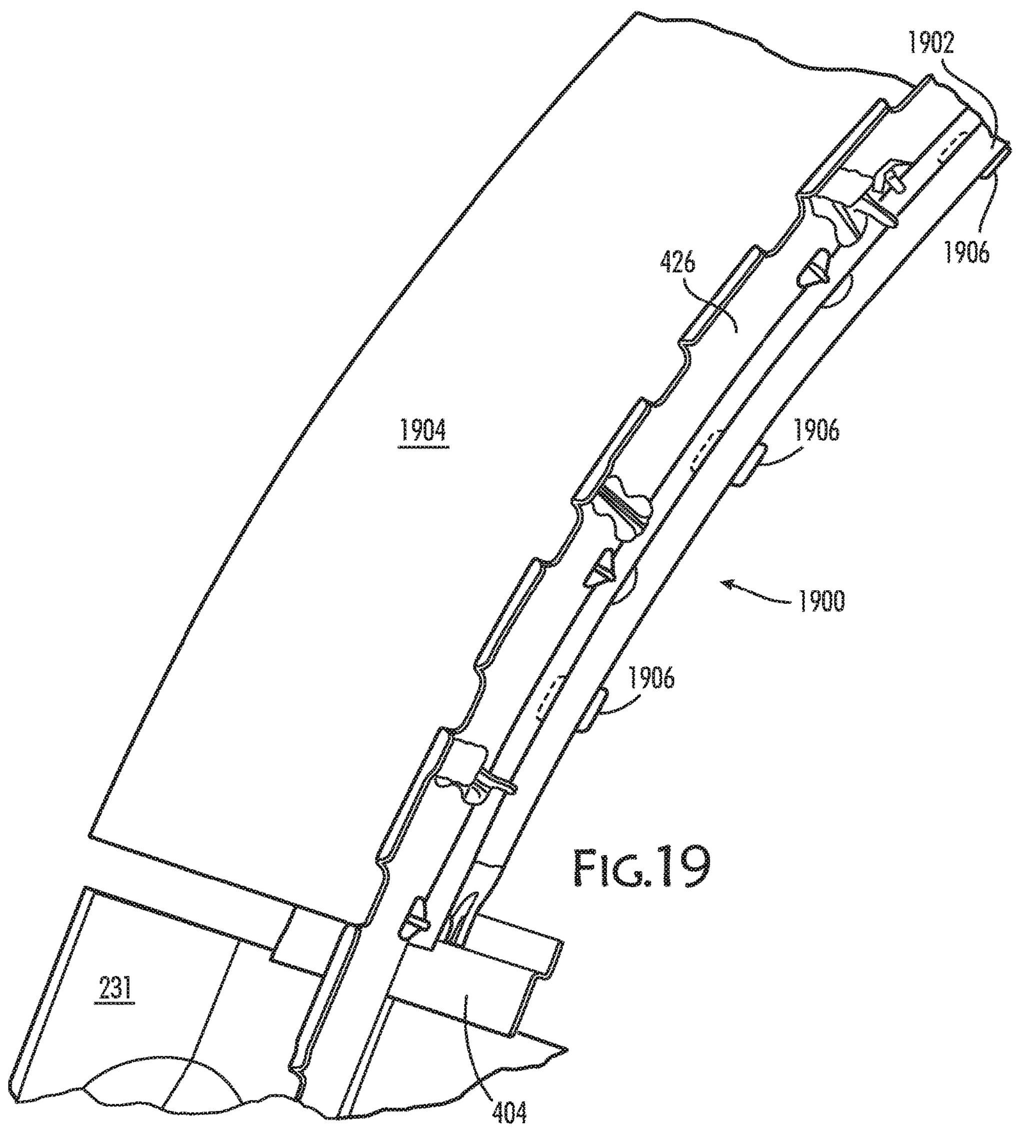

FIG.19

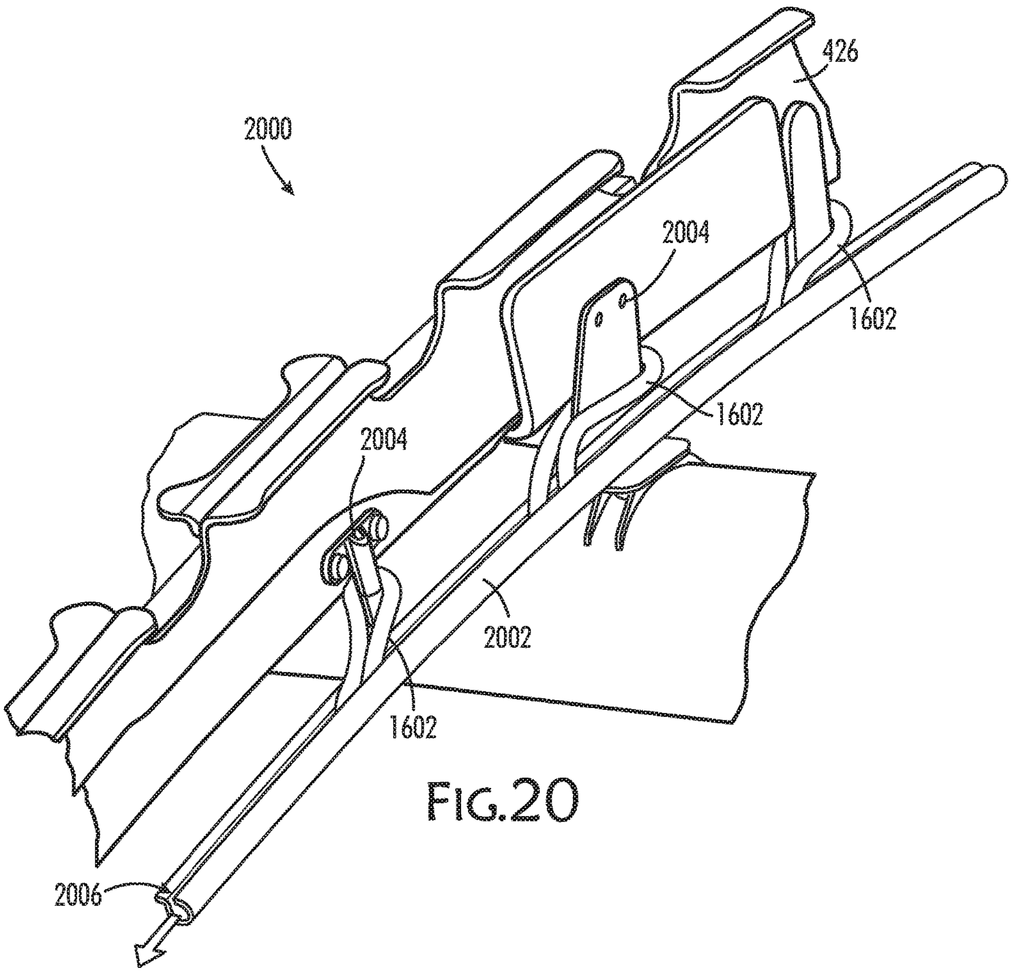

FIG.20

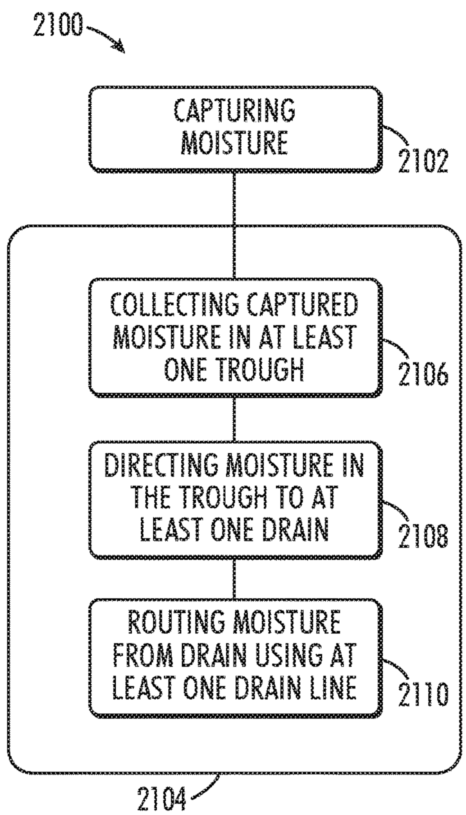
2100
CAPTURING MOISTURE
2102
COLLECTING CAPTURED MOISTURE IN AT LEAST ONE TROUGH
2106
DIRECTING MOISTURE IN THE TROUGH TO AT LEAST ONE DRAIN
2108
ROUTING MOISTURE FROM DRAIN USING AT LEAST ONE DRAIN LINE
2110
2104

FIG.21

MOISTURE DIVERSION SYSTEMS AND METHODS OF USING SAME

FIELD

The present disclosure generally relates to the moisture control field. More particularly, the present disclosure relates to the field of moisture control in a vehicle.

BACKGROUND

In an aircraft, the outer skin is spaced from the walls and ceiling of a passenger cabin (or other compartment), and the gap is at least partially filled with an insulation layer or blanket. The insulation layer is typically formed from a waterproof material. During a flight, liquid from moist air can condense against the skin, particularly at the top of the fuselage, and freeze during cruise. During decent, this frozen liquid can thaw and drip back down towards the cabin. Because the insulation blanket is waterproof, the condensate can typically flow along the insulation blanket and drain into the bilge. However, at some locations, structures and/or supports can protrude through the insulation blanket. For example, the supports that hold monuments and stowage bins to the crown extend from the structure at the skin, through the insulation blanket, and into the cabin. The insulation blankets come with predefined holes for the supports to extend through the blanket. The holes are lined, and there may be a gap defined between the inner surface of the hole and the support. When liquid thaws, it can drip down through the hole and into the cabin.

Further compounding the issue of holes predefined in the blanket, sometimes during maintenance and/or repair the insulation blankets are dislocated from their original intended position and because the blankets are generally flexible with little shape memory, they will not usually return to their intended position naturally. This dislocation of the blanket will sometimes result in a deterioration of the blanket's ability to properly channel liquid moisture towards the bilge at the bottom of the plane fuselage thereby causing liquid moisture to drip towards the passenger cabin.

Previous attempts at controlling undesirable moisture from dripping into the passenger cabin also include using moisture control felt. While the use of the moisture control felt provides an incremental improvement over not using felt at all, it has been discovered that on flights of long duration and/or with many passengers and/or in high humidity environments the moisture control felt can become saturated and at least partially ineffective, resulting in moisture dripping into the passenger cabin.

BRIEF SUMMARY

There is provided, a moisture diversion system of an aircraft for capturing moisture from at least one internal aircraft structure or at least one gap, the moisture diversion system comprising: a drip shield with an upper surface having a concave shape, at least one moisture channel disposed in the upper surface of the drip shield, the drip shield being in a moisture capturing orientation under the at least one internal aircraft structure or the at least one gap. In an aspect, the system further comprises a trough comprising an outboard wall and an inboard wall, the outboard wall and the inboard wall defining a recessed liquid conduit therebetween, the trough disposed substantially perpendicular to, and in fluid communication with, a lower segment or a bottom portion of the drip shield; coupled in fluid communication with the trough, a drain including a drain aperture extending into the liquid conduit to draw moisture from the liquid conduit into the drain; and a drain tube connected in fluid communication to the drain for routing moisture away from a passenger cabin of the aircraft.

In an aspect, the moisture diversion system further comprises a trough comprising an outboard wall and an inboard wall, the outboard wall and the inboard wall defining a recessed liquid conduit therebetween, the trough disposed substantially perpendicular to, and in fluid communication with, a lower segment or a bottom portion of the drip shield.

In an aspect, the moisture diversion system further comprises a drain coupled in fluid communication with the trough, the drain including a drain aperture extending into the liquid conduit to draw moisture from the liquid conduit into the drain.

In an aspect, the moisture diversion system further comprises a drain tube connected in fluid communication to the drain for routing moisture away from a passenger cabin of the aircraft.

In an aspect, the moisture diversion system further comprises comprising a drain stop disposed on at least one of the outboard wall and the inboard wall of the trough such that the drain stop extends down into the liquid conduit to obstruct moisture flow within the liquid conduit.

In an aspect, the at least one moisture channel comprises a plurality of moisture channels, the system further comprising a central bead disposed between two moisture channels of the plurality of moisture channels.

In an aspect, the moisture diversion system further comprises a central bead defined on the upper surface of the drip shield, the central bead comprising a first central bead portion and a second central bead portion, wherein a break is between the first central bead portion and the second central bead portion.

In an aspect, the moisture diversion system further comprises at least one joggle in the drip shield.

In an aspect, the drip shield is tubular shaped and includes an open slot facing the at least one internal aircraft structure or at least one gap.

In an aspect, the moisture diversion system further comprises a wicking necklace disposed in fluid communication with the at least one internal aircraft structure or at least one gap and the drip shield, the wicking necklace configured to wick moisture from the at least one internal aircraft structure or at least one gap into the drip shield.

In an aspect, the drip shield comprises a plurality of segments. In an aspect, at least two of the plurality of segments are attached together. In an aspect, the drip shield comprises an upper segment, a middle segment, and a lower segment.

In an aspect, the moisture diversion system further comprises a hole disposed in a junction of two of the segments for passage of an internal aircraft structure therethrough. In an aspect, a bead extends around the hole.

In an aspect, the moisture diversion system further comprises at least one slot disposed in the upper segment for mounting the drip shield to a second internal aircraft structure.

In an aspect, the moisture diversion system further comprises at least one snap flange disposed on the at least one slot and biased upwardly, the at least one snap flange configured to snap the upper segment onto the second internal aircraft structure.

In an aspect, the drip shield includes fasteners to fasten the drip shield directly to an insulation blanket.

There is further provided, a method of using a moisture diversion system for capturing moisture from an internal aircraft structure using at least one drip shield in a moisture capturing location relative to the internal aircraft structure, the method comprising: capturing moisture from the internal structure in the at least one drip shield; and, transporting the captured moisture in the at least one drip shield.

In an aspect, the method of using a moisture diversion system further comprises collecting captured moisture in a trough comprising an outboard wall and an inboard wall, the outboard wall and the inboard wall defining a recessed liquid conduit therebetween, the trough disposed substantially perpendicular to, and in fluid communication with, a lower segment or a bottom portion of the drip shield; directing moisture in the trough to at least one drain, the drain coupled in fluid communication with the trough and including a drain aperture extending into the liquid conduit to draw moisture from the liquid conduit into the drain; and routing moisture from the drain to a drain tube connected in fluid communication to the drain for routing moisture away from a passenger cabin of the aircraft.

Unless otherwise defined, all technical and/or scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which the disclosure pertains. Although methods and materials similar or equivalent to those described herein can be used in the practice or testing of aspects of the disclosure, exemplary methods and/or materials are described below. In case of conflict, the patent specification, including definitions, will control. In addition, the materials, methods, and examples are illustrative only and are not intended to be necessarily limiting.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

Some aspects of the disclosure are herein described, by way of example only, with reference to the accompanying drawings. With specific reference now to the drawings in detail, it is stressed that the particulars shown are by way of example, are not necessarily to scale, and are for purposes of illustrative discussion of aspects of the disclosure. In this regard, the description taken with the drawings makes apparent to those skilled in the art how aspects of the disclosure may be practiced.

In the drawings:

FIG. **1** is a schematic diagram of an aircraft;

FIG. **2** is an exemplary cross-sectional, schematic view of the aircraft shown in FIG. **1**;

FIG. **3** is a block diagram of an exemplary moisture diversion system;

FIG. **4** is a perspective, partial view of the moisture diversion system shown in FIG. **3**;

FIG. **5** is a perspective view of an exemplary drip shield that can be used with the moisture diversion system of FIGS. **3** and **4**;

FIG. **6** is a perspective view of an exemplary drip shield with at least one joggle that can be used with the moisture diversion system of FIGS. **3** and **4**;

FIGS. **7**A-**7**B are perspective views of an exemplary installed drip shield with at least one joggle of FIG. **6**;

FIG. **8** is a perspective view of an exemplary drip shield with at least one central bead break that can be used with the moisture diversion system of FIGS. **3** and **4**;

FIG. **9** is a perspective view of a drain line portion of a moisture diversion system of FIGS. **3** and **4**;

FIG. **10** is a perspective view of a lower segment of a drip shield of a moisture diversion system of FIGS. **3** and **4**;

FIG. **11** is a perspective view of a trough and drain of a moisture diversion system of FIGS. **3** and **4**;

FIG. **12** is a perspective view of an exemplary installed moisture diversion system of FIGS. **3** and **4** in relation to an insulation blanket;

FIG. **13** is close-up, perspective view of exemplary moisture flow in an exemplary drip shield of a moisture diversion system of FIGS. **3** and **4** and around a fitting;

FIG. **14** is a close-up, perspective view of a junction, between a lower segment of a drip shield and a middle segment of a drip shield of a moisture diversion system of FIGS. **3** and **4**, at a fitting;

FIG. **15** is a close-up, perspective view of a junction between an upper segment of a drip shield and a middle segment of a drip shield of a moisture diversion system of a moisture diversion system of FIGS. **3** and **4**;

FIG. **16** is a close-up, perspective view of a felt necklace of a moisture diversion system of a moisture diversion system of FIGS. **3** and **4**;

FIG. **17** is perspective view of a moisture diversion system including at least one one-piece drip shield;

FIG. **18** is a perspective view of a lower portion of a one-piece drip shield of a moisture diversion system of FIG. **17**;

FIG. **19** is a perspective view of a moisture diversion system attached to an exemplary insulation blanket;

FIG. **20** is a perspective view of a crown-based moisture diversion system; and,

FIG. **21** is a flowchart of a method of using a moisture diversion system of a moisture diversion system of FIGS. **3**, **4**, **17**, **19** and **20**.

DETAILED DESCRIPTION

The present disclosure generally relates to the moisture control field. More particularly, the present disclosure relates to the field of moisture control in a vehicle.

Before explaining at least one aspect of the disclosure in detail, it is to be understood that the disclosure is not necessarily limited in its application to the details of construction and the arrangement of the components and/or methods set forth in the following description and/or illustrated in the drawings and/or the Examples. The disclosure is capable of other aspects or of being practiced or carried out in various ways.

FIGS. **1** and **2** illustrate an exemplary aircraft and exemplary moisture flow within an exemplary aircraft, and FIGS. **3-20** show exemplary moisture diversion systems, or components thereof, for preventing or at least minimizing moisture flow into an inner cabin portion of the aircraft, according to some aspects of the disclosure. FIG. **1** shows an aircraft **100** that includes a nose **110**, wings **120**, a fuselage **130**, and a tail **140**. FIG. **1** also illustrates a downward arrow **150** indicating the expected direction in which the force of gravity will pull objects, such as liquid water, onboard an aircraft **100** in a nominal operational profile. As used herein, “down”, “downward” and “bottom” generally correspond to the direction of arrow **150**, while “up”, “upper” and “top” are generally in the opposite direction of the arrow **150**.

FIG. **2** is a cross-sectional, schematic view of the aircraft **100** indicated by view arrows **2** in FIG. **1**. FIG. **2** illustrates a portion of the aircraft fuselage **130**, simplified for easier understanding of this Description. The fuselage **130** includes side walls **231**, a ceiling **232**, and a floor **233**, which define the passenger cabin **230**. Passengers in the aircraft **100** may congregate in seats **202** of the cabin **230** during flight. FIG. **2** illustrates that, inside of the fuselage **130** (e.g. in cabin **230**), respiration and other sources of water cause moisture **240** to enter or form in the air in the cabin **230**. For example, warm exhaled air includes moisture **240** and rises upward through luggage compartments/stowage bins **270**. Some of this warm and moist air rises through the ceiling **232**. Furthermore, some warm air continues to rise upward through an insulation layer **220** (or insulation blanket) into a space **250** between the insulation layer **220** and an outer wall **210** of the aircraft, also known as the aircraft skin, particularly in the crown/upper area of the fuselage.

As the skin **210** is cooled by the outside air at high altitude during flight, the temperature of the skin **210** eventually decreases to a temperature below the freezing temperature of water. This cooling causes moisture **240** (e.g., water) to condense out of the air in the space **250** and freeze onto the inner surface of the skin **210** as ice **242**. As the aircraft changes to a lower altitude and/or commences descent for landing and the temperature increases, the ice **242** can begin to melt causing moisture droplets **244** to travel through the space **250** towards the bottom **260** of the fuselage **130**, drawn by gravity **150**. Some moisture droplets **244** enter gaps in the insulation layer **220**, drip on top of structures in the fuselage, such as the ceiling **232** and the stowage bins **270**, and subsequently into the cabin **230**. The size of the space **250** has been exaggerated somewhat in FIG. **2** in order to more clearly show the details of the structure. For simplicity, common aircraft load bearing components such as stringers and/or frame members are not shown in FIG. **2**, but examples are shown in FIG. **4**, inter alia.

FIG. **3** is a generalized block diagram of a moisture diversion system **300** that can be used with the aircraft **100** shown in FIGS. **1** and **2**. Moisture diversion systems **400**, **1700**, **1900**, **2000** described herein with respect to FIGS. **4**, **17**, **19**, and **20**, inter alia, set forth specific moisture diversion system configurations of generalized moisture diversion system **300**. For example, exemplary drip shields **402**, **500**, **600**, **800**, **1702**, **1902**, **2002** can be used as drip shield **302** and are shown and described in more detail with respect to FIGS. **4-8**, **17**, **19** and **20**, inter alia, but it should be understood that these drip shields are by way of example only and that virtually any structure capable of catching and directing moisture flow could conceivably be used as a "drip shield" **302** in the moisture diversion system **300**, or any of the specific moisture diversion systems described herein.

Generally, the moisture diversion systems described herein are configured to prevent, or at least diminish, the possibility of liquid moisture dripping through or down internal aircraft structures like frames, stringers, insulation blankets, fittings, and/or brackets and into the cabin **230**. The moisture diversion system **300** includes at least one drip shield **302** to provide fluidic communication between an internal aircraft structure where moisture drips down or through and a portion of the aircraft **100** where the moisture cannot intrude into the cabin **230**, for example the bottom **260** of the fuselage. In some aspects, the drip shield **302** is positioned in a moisture capturing orientation under a potential source of inboard moisture intrusion, for example a gap in an insulation blanket, to capture the moisture and/or route the captured moisture away from the cabin **230** to prevent, or at least reduce, moisture ingress into the cabin **230**. In an aspect, "moisture capturing orientation" means with the drip shield **302** under the internal aircraft structure where liquid moisture subject to gravity and/or aircraft vibration would drip substantially in direction **150** and into the drip shield **302**.

In an aspect, usage of a moisture diversion system such as those described herein reduces or eliminates the need for moisture absorbing felt, which is conventionally used to capture unwanted moisture, but often ineffectually or only partially.

In some aspects, the moisture diversion system **300** is provided with at least one trough **304**, with a specific example of trough **404** shown and described in more detail with respect to FIGS. **4**, **10** and **11**, to collect moisture running down from at least one drip shield **302**. In some aspects, the at least one trough **304** directs collected moisture to at least one drain **306**, with a specific example of a drain **406** shown and described in more detail with respect to FIGS. **4**, **9** and **11**. In some aspects, the drain **306** is connected to at least one drain line **308**, with a specific example of a drain line **408** shown and described in more detail with respect to FIGS. **4**, **9** and **11**. The drain line **308** directs moisture collected by the moisture diversion system **300** downstream towards a bilge located near the bottom **260** of the fuselage **130**, which pumps the moisture into a storage reservoir. It should be understood that at least some of the components described herein, for example the trough **304**, the drain **306**, and/or the drain line **308**, are optional and that the moisture diversion systems described herein could be configured to route moisture away from the cabin **230** without some or all of them. It should also be understood that all of the components described herein of the moisture diversion system **300** are disposed to be in fluid communication with the component upstream and the component downstream, if one exists. For example, the drip shield **302** is disposed in fluid communication with the trough **304**, and so on.

FIG. **4** is a perspective, partial view of an exemplary moisture diversion system **400**. The moisture diversion system **400** includes at least one drip shield **402**. In some aspects, the moisture diversion system **400** also includes at least one trough **404**, at least one drain **406**, and/or at least one drain line **408**. In an aspect, at least one drip shield **402** is installed under a gap in an insulation blanket (not shown) to collect moisture penetrating through the gap, from outboard of the insulation blanket to inboard, and direct the moisture down the drip shield **402** to the trough **404**, into the drain **406**, and, subsequently into the drain line **408**, whereupon the moisture is routed to a portion of the aircraft **100** where the moisture cannot enter the cabin **230**.

The drip shield **402** is configured with at least one moisture channel **410** for routing captured moisture away from the cabin **230**. In some aspects, the drip shield **402** is linear and/or elongated, for example to increase moisture capturing area under a row of internal aircraft structures or gaps and/or to provide a moisture transporting structure to direct captured moisture away from the internal aircraft structure and/or in an outboard direction away from the passenger cabin **230**. In some aspects, the drip shield **402** is generally concave-shaped on an upper surface of the drip shield **402**, the upper surface being the surface which faces the internal aircraft structures for capturing dripping moisture when the drip shield **402** is in moisture capturing orientation. In some aspects, the moisture channel **410**, disposed on the upper surface of the drip shield **402**, is contoured to enhance fluid flow therein, and/or to minimize moisture escape from the moisture channel **410**. For example, a central bead **412** is provided in the middle of the moisture channel **410** for diverting moisture away from any holes in the drip shield **402**, such as shown in FIGS. **13** and **14** where a fitting penetrates the drip shield **402**. The central bead **412** can keep an insulation blanket lifted away from the moisture channel **410** to ensure unobstructed moisture flow in the moisture channel **410** and/or help stiffen the drip shield **402** where the bead **412** traverses over structures of the aircraft **414**. In some aspects, the drip shield **402** is comprised of three separate but attachable segments, an upper segment **416** (shown and described in more detail with respect to FIG. **15**), a middle segment **418**, and a lower segment **420** (shown and described in more detail with respect to FIGS. **10** and **11**).

In some aspects, the drip shield **402** is constructed of fiberglass, or a thermal plastic, or similar water-proof material. In some aspects, the drip shield **402** is constructed of a slightly flexible material and/or is configured with a thickness which allows some flexibility of the drip shield **402**. In some aspects, the drip shield **402** is constructed of a light weight material, for example no more than 15 lbs. (about 6.8 kg) per airplane. In some aspects, the drip shield **402** is between 5 in. and 10 in. (about 12.7 cm to 25.4 cm) wide and between 10 in. and 30 in. (about 25.4 cm to 76.2 cm) long, although different shapes and sizes of drip shield could be used depending on the perceived risk of moisture intrusion.

In some aspects, a moisture diversion system, for example moisture diversion system **400**, is installed any place in the aircraft's **100** infrastructure where there are penetrations of internal aircraft structures which traverse inboard from the space **250** towards the cabin **230**. For example, the moisture diversion system **400** is shown in FIGS. **4** and **12**, inter alia, where strongbacks **422** of stowage bin **270** are located because the strongbacks **422** are attached by fittings **424** to stringers and/or frame members **426**. The fittings **424** penetrate the insulation layer **220** to connect the frame member **426** to the strongback **422**, thereby creating gaps in the insulation blanket/layer for moisture to exploit.

FIG. **5** is a perspective view of an exemplary drip shield **500**, which could be used as drip shield **302** in the generalized moisture diversion system **300**. In an aspect, the drip shield **500** comprises three discrete sections, an upper segment **502**, a middle segment **504** and a lower segment **506**. Two or more segments are attached to each other in some aspects, for example using tape, adhesive, snaps, and/or interlocking counterparts located on the segments themselves. In an aspect, the drip shield **500** is contoured to facilitate moisture flow therein, for example configured with at least one central bead **412** and at least one moisture channel **508**.

FIG. **6** is a perspective view of an exemplary drip shield **600**, which could be used as drip shield **302** in the generalized moisture diversion system **300**, with at least one joggle **602**. In an aspect, at least one joggle **602** disposed in the drip shield **600** to avoid internal aircraft structures past which the shield **600** traverses. For example, the joggle(s) are configured to accommodate the fitting **604** and/or the fittings **702** (shown in FIGS. 7A and 7B). It should be noted that drip shield **600** is shown as being constructed from a single piece, and is not three-piece like drip shields **402**, **500**, however, for nearly all of the drip shield iterations and variations described herein, the drip shield **600** can be comprised of any number of segments and can include one, some, or all of the features described herein, for example at least one joggle or at least one break **802** in the central bead **412**, in one, some, or all segments.

FIG. **8** is a perspective view of an exemplary drip shield **800**, which could be used as drip shield **302** in the generalized moisture diversion system **300**, with at least one break **802** between adjacent central beads **412**. In an aspect, the break **802** is used to accommodate fittings or structures (similarly to the joggle **602**), but for less intrusive or prominent structures than when the joggle **602** is used. For example, a break **802** instead of a joggle **602** is used where a fitting does not extend sufficiently into the path of the drip shield **800** such that a larger path deviation (i.e. a joggle) of the drip shield is needed.

FIG. **9** is a perspective view of an exemplary drain line **408** of the moisture diversion system **400**. In an aspect, the drain **406** collects moisture flowing from the drip shield **402** and the trough **404** and directs it into the drain line **408** which transports the moisture down the fuselage **130** outboard of the side wall **231**. In an aspect, the drain line **408** is shaped substantially like a tube. Optionally, the drain line **408** is flexible and/or bendable, for example to assist with navigating through and/or around aircraft **100** structures/features (such as windows). The drain line **408** extends sufficiently down the fuselage **130** such that moisture discharged from the drain line **408** will be transported by gravity down and away from the cabin **230**, for example towards the bottom **260** of the fuselage **130**. The drain line **408** ends below a window dimmer switch **902**, in some aspects.

FIG. **10** is a perspective view of a lower segment **420** of the drip shield **402** of the moisture diversion system **400**. In an aspect, the lower segment is configured to extend the drip shield **402** around and/or past internal aircraft structures, for example the strongback **422**. FIG. **10** also shows that the lower segment **420** and the middle segment **418** intersect where the fitting **424** penetrates through the drip shield **402**, such that in a retrofitting scenario, the drip shield **402** can be installed without having to disconnect the fitting **424** (i.e. each segment is inserted on either side of the fitting and then attached together). In some aspects, the drip shield **402** is shaped and/or positioned such that it intersects with the fitting **424** where the fitting **424** has a narrow cross-section.

FIG. **11** is a perspective view of the trough **404** and drain **406** of the moisture diversion system **400**, including the drain line **408**. The lower segment **420** or bottom portion (for example, if the drip shield is one-piece) of the drip shield **402** delivers, in fluid communication, moisture collected by the drip shield **402** into the trough **404**, which is then routed into the drain **406**. In an aspect, the trough **404** is longitudinal and comprises an outboard wall **1102** and an inboard wall **1104** which define a recessed liquid conduit **1106** between them. In some aspects, the trough **404** is disposed substantially perpendicular to the drip shield(s) **402**. In some aspects, the drain **406** is configured with a drain aperture **1108** which extends into the liquid conduit **1106** to draw moisture from the liquid conduit **1106** into the drain **406**.

FIG. **12** is a perspective view of an exemplary installed moisture diversion system **400** in relation to an exemplary insulation blanket layer **1202**. In some aspects, drip shields **402** are installed inboard of frame members **426** and the insulation blanket layer **1202** but outboard of stowage bin strongbacks **422**.

FIG. **13** is close-up, perspective view of exemplary moisture flow **1302**, **1304** in an exemplary drip shield **402** and around a fitting **424**. As described elsewhere herein, particularly with respect to FIG. **4**, the central bead **412** creates two moisture channels **410**, similar to gutters, on either side of the central bead **412** to provide for unobstructed moisture flow **1302** down the drip shield **402** and away from the cabin **230**. The central bead **412** extends past where the fitting **424** penetrates the drip shield **402** to divert moisture flow away from a hole **1306** created where the fitting **424** passes through. The central bead **412** extending past the fitting **424** is also useful for diverting moisture flow **1304** dripping from the fitting **424** itself into the moisture channels **410** and away from the hole **1306**.

FIG. **14** is a close-up, perspective view of a junction, between the lower segment **420** and the middle segment **418** of the drip shield **402** of moisture diversion system **400**, at a fitting **424**. FIG. **14** provides an alternative view to FIG. **13** of the moisture flow **1302** down the moisture channels **410** and around the fitting **424**.

FIG. **15** is a close-up, perspective view of a junction between the upper segment **416** of the drip shield **402** and the middle segment **418** of the drip shield **402** of a moisture diversion system **400**. In an aspect, at least a portion of the upper segment **416** is provided with at least one slot **1502** configured as a counterpart to a stowbin upper attachment fitting **1506**, such that the stowbin upper attachment fitting **1506** projects through the slot **1502** and the drip shield **402** is reversibly attached to the stowbin upper attachment fitting **1506** by an upwardly biased flange **1504** which snaps into at least one recess **1508** on stowbin upper attachment fitting **1506**. In an aspect, the drip shield **402** can be detached from stowbin upper attachment fitting **1506** by unsnapping the upwardly biased flange **1504** from the at least one recess **1508**. It should be noted that for clarity, only one stowbin upper attachment fitting **1506** is shown but that in some aspects there are actually two or more. Optionally, there are none. There is a slot **1502** provided in the drip shield **402** for each stowbin upper attachment fitting **1506**, in an aspect.

FIG. **16** is a close-up, perspective view of a felt necklace **1602** which could be used with any of the moisture diversion systems **300**, **400**, **1700**, **1900**, **2000** described herein. In some aspects, a wicking structure, such as the felt necklace **1602**, is used to directly wick moisture into the drip shield **402**. For example, the felt necklace **1602** is placed in fluid communication with a fitting **424** such that moisture dripping down the fitting **424** is wicked up by the felt necklace **1602** and into the drip shield **402**. It should be understood that any wicking substance could be used to perform the described task, even though moisture wicking felt is used as an example herein.

FIG. **17** is perspective view of an exemplary moisture diversion system **1700** including at least one one-piece drip shield **1702**. In some aspects, at least one one-piece drip shield **1702** is used in a moisture diversion system, for example where there aren't fittings that need to be accounted for (that are passing through the drip shield) and/or in situations where the moisture diversion system is not being retrofitted into an aircraft. As shown in FIG. **17**, the one-piece drip shield **1702** can be installed between the strongbacks **422** because there are no fittings **424** which are needed for attaching the strongbacks **422** to a frame member **426** or stringer, unlike with the three-piece drip shield **402** that is shown installed at the strongback **422** location.

In an aspect, at least one drain stop **1704** is provided to a trough **404** in order to stop moisture flow within the trough **404** at that specific point. In an aspect, the drain stop **1704** is situated onto at least one of the outboard wall **1102** and the inboard wall **1104** of the trough **404** such that the drain stop **1704** extends down into the liquid conduit **1106** to obstruct moisture flow within the liquid conduit **1106**. The drain stop **1704** could conceivably be used with any of the moisture diversion systems described herein. In some aspects, the drain stop **1704** does not completely obstruct flow, but merely limits it, for example to provide overflow for an adjacent trough if the moisture level within the adjacent trough rises to an undesirable level.

FIG. **18** is a perspective view of a lower portion of a one-piece drip shield **1702** of a moisture diversion system **1700**, which also shows the at least one drain stop **1704** in additional detail.

FIG. **19** is a perspective view of an exemplary moisture diversion system **1900**, where the drip shield **1902** is configured to attach to an exemplary insulation blanket **1904**, where the insulation blanket **1904** is correspondingly configured to attach to the drip shield **1902**. For clarity, only one insulation blanket **1904** is shown. In an aspect, the moisture diversion system **1900** is not merely located under the insulation blanket/layer **1904**, but is additionally directly attached to each insulation blanket **1904**. The ends of the insulation blanket **1904** include fasteners **1906** which attach the ends of each insulation blanket to a drip shield **1902** which includes counterpart fasteners, for example a hook and loop fastening system.

FIG. **20** is a perspective view of a moisture diversion system **2000** which, in an aspect, is used in the crown of an aircraft fuselage where there are many internal structures **2004**, such as brackets and fittings attached to frame members **426**, creating relatively tight spaces and many gaps in the insulation layer **220** where they pass through. The moisture diversion system **2000** includes a drip shield **2002** which is substantially tubular but with a slot **2006** opening for capturing moisture dripping from the internal structures **2004**, where the slot **2006** is positioned under the internal structures **2004** to capture dripping moisture. A tubular design is used, in some aspects, because it can be compact and/or exhibit excellent moisture containment characteristics. In some aspects, at least one wicking necklace **1602** is used to wick moisture away from the internal structures **2004** and into the drip shield **2002**, optionally into the slot **2006**. Additionally, the drip shield **2002** can be provided with a flange, or flat surface, for adhering the wicking necklace **1602** thereto, thereby securing the relationship of the wicking necklace **1602** to the drip shield **2002**. Optionally, the moisture diversion system **2000** uses multi-segment drip shields like those described elsewhere herein, which are installed piece-by-piece between the internal structures **2004**.

FIG. **21** is a flowchart **2100** of a method of using a moisture diversion system, such as any of the moisture diversion systems **300**, **400**, **1700**, **1900**, **2000** described herein. At least one drip shield **302** of the moisture diversion system **300** is installed in a moisture capturing location, for example under a gap in an insulation blanket. Moisture dripping through the gap is captured (**2102**) by the drip shield **302** and is transported (**2104**) by at least the drip shield **302** away from the passenger cabin **230**. In some aspects, at least one trough **304** collects (**2106**) moisture captured (**2102**) by the drip shield **302** to transport (**2104**) the moisture away from the passenger cabin **230**. Optionally, moisture in the trough is directed (**2108**) to at least one drain **306** to transport (**2104**) the moisture away from the passenger cabin **230**. In some aspects, the at least one drain **306** is connected to a drain line **308** to route (**2110**) the moisture away from the passenger cabin **230**. It should be understood that one or some of these actions can be performed separately and/or optionally.

The terms "comprises", "comprising", "includes", "including", "having" and their conjugates mean "including but not limited to".

The term "consisting of" means "including and limited to".

The term "consisting essentially of" means that the composition, method or structure may include additional ingredients, steps and/or parts, but only if the additional ingredients, steps and/or parts do not materially alter the basic and novel characteristics of the claimed composition, method or structure.

As used herein, the singular form “a”, “an” and “the” include plural references unless the context clearly dictates otherwise. For example, the term “a compound” or “at least one compound” may include a plurality of compounds, including mixtures thereof.

Throughout this application, various aspects of this disclosure may be presented in a range format. It should be understood that the description in range format is merely for convenience and brevity and should not be construed as an inflexible limitation on the scope of the disclosure. Accordingly, the description of a range should be considered to have specifically disclosed all the possible subranges as well as individual numerical values within that range. For example, description of a range such as from 1 to 6 should be considered to have specifically disclosed subranges such as from 1 to 3, from 1 to 4, from 1 to 5, from 2 to 4, from 2 to 6, from 3 to 6 etc., as well as individual numbers within that range, for example, 1, 2, 3, 4, 5, and 6. This applies regardless of the breadth of the range. Further, described ranges are intended to include numbers outside any range described within statistical error and/or inherent measurement equipment limitations.

Whenever a numerical range is indicated herein, it is meant to include any cited numeral (fractional or integral) within the indicated range. The phrases “ranging/ranges between” a first indicate number and a second indicate number and “ranging/ranges from” a first indicate number “to” a second indicate number are used herein interchangeably and are meant to include the first and second indicated numbers and all the fractional and integral numerals therebetween.

It is appreciated that certain features of the disclosure, which are, for clarity, described in the context of separate aspects, may also be provided in combination in a single aspect. Conversely, various features of the disclosure, which are, for brevity, described in the context of a single aspect, may also be provided separately or in any suitable subcombination or as suitable in any other described aspect of the disclosure. Certain features described in the context of various aspects are not to be considered essential features of those aspects, unless the aspect is inoperative without those elements.

Although the disclosure has been described in conjunction with specific aspects thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, it is intended to embrace all such alternatives, modifications and variations that fall within the spirit and broad scope of the appended claims.

All publications, patents and patent applications mentioned in this specification are herein incorporated in their entirety by reference into the specification, to the same extent as if each individual publication, patent or patent application was specifically and individually indicated to be incorporated herein by reference. In addition, citation or identification of any reference in this application shall not be construed as an admission that such reference is available as prior art to the present disclosure. To the extent that section headings are used, they should not be construed as necessarily limiting.

What is claimed is:

1. A moisture diversion system of an aircraft for capturing moisture from at least one internal aircraft structure or at least one gap, the moisture diversion system comprising:

a drip shield with an upper surface having a concave shape, at least one moisture channel disposed in the upper surface of the drip shield, the drip shield being in a moisture capturing orientation under the at least one internal aircraft structure or the at least one gap; and

a trough comprising an outboard wall and an inboard wall, the outboard wall and the inboard wall defining a recessed liquid conduit therebetween, the trough disposed substantially perpendicular to, and in fluid communication with, a lower segment or a bottom portion of the drip shield.

2. The moisture diversion system according to claim **1**, further comprising a drain coupled in fluid communication with the trough, the drain including a drain aperture extending into the liquid conduit to draw moisture from the liquid conduit into the drain.

3. The moisture diversion system according to claim **2**, further comprising a drain tube connected in fluid communication to the drain for routing moisture away from a passenger cabin of the aircraft.

4. The moisture diversion system according to claim **1**, further comprising a drain stop disposed on at least one of the outboard wall and the inboard wall of the trough such that the drain stop extends down into the liquid conduit to obstruct moisture flow within the liquid conduit.

5. The moisture diversion system according to claim **1**, wherein the at least one moisture channel comprises a plurality of moisture channels, the system further comprising a central bead disposed between two moisture channels of the plurality of moisture channels.

6. The moisture diversion system according to claim **1**, further comprising a central bead defined on the upper surface of the drip shield, the central bead comprising a first central bead portion and a second central bead portion, wherein a break is between the first central bead portion and the second central bead portion.

7. The moisture diversion system according to claim **1**, further comprising at least one joggle in the drip shield.

8. The moisture diversion system according to claim **1**, wherein the drip shield is tubular shaped and includes an open slot facing the at least one internal aircraft structure or at least one gap.

9. The moisture diversion system according to claim **1**, further comprising a wicking necklace disposed in fluid communication with the at least one internal aircraft structure or at least one gap and the drip shield, the wicking necklace configured to wick moisture from the at least one internal aircraft structure or at least one gap into the drip shield.

10. The moisture diversion system according to claim **1**, wherein the drip shield comprises a plurality of segments.

11. The moisture diversion system according to claim **10**, wherein the drip shield comprises an upper segment, a middle segment, and a lower segment.

12. The moisture diversion system according to claim **11**, further comprising a hole disposed in a junction of two of the segments for passage of an internal aircraft structure therethrough.

13. The moisture diversion system according to claim **12**, wherein a bead extends around the hole.

14. The moisture diversion system according to claim **11**, further comprising at least one slot disposed in the upper segment for mounting the drip shield to a second internal aircraft structure.

15. The moisture diversion system according to claim 14, further comprising at least one snap flange disposed on the at least one slot and biased upwardly, the at least one snap flange configured to snap the upper segment onto the second internal aircraft structure.

16. The moisture diversion system according to claim 10, wherein at least two of the plurality of segments are attached together.

17. The moisture diversion system according to claim 1, wherein the drip shield includes fasteners to fasten the drip shield directly to an insulation blanket.

18. A method of using a moisture diversion system for capturing moisture from an internal aircraft structure using at least one drip shield in a moisture capturing location relative to the internal aircraft structure, the method comprising:

capturing moisture from the internal structure in the at least one drip shield; and,

diverting the captured moisture away from a central bead and into first and second moisture channels that extend along opposing sides of the central bead and transporting the captured moisture in the at least one drip shield.

19. The method of using a moisture diversion system of claim 18, further comprising:

collecting captured moisture in a trough comprising an outboard wall and an inboard wall, the outboard wall and the inboard wall defining a recessed liquid conduit therebetween, the trough disposed substantially perpendicular to, and in fluid communication with, a lower segment or a bottom portion of the drip shield;

directing moisture in the trough to at least one drain, the drain coupled in fluid communication with the trough and including a drain aperture extending into the liquid conduit to draw moisture from the liquid conduit into the drain; and

routing moisture from the drain to a drain tube connected in fluid communication to the drain for routing moisture away from a passenger cabin of the aircraft.

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